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SPRAY AND PRACTICE OUTLINE FOR 1914

BY

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1-69—70M.

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GENERAL TREATMENT FOR SPRAYING APPLE ORCHARDS.

In the winter or early spring, inspect the trees for San Jose, scurfy or oyster-shell scale. (Send twigs and strips of bark to the entomologist of the Experiment Station, if you cannot identify the scale yourself.)

These scale insects, especially the San Jose scale, must be destroyed promptly or they will kill the trees.

JUST BEFORE THE BUDS OPEN, if the scale be present, spray with the *strong* lime-sulphur wash. To be successful, the work must be done very thoroughly—this means that *every part* of the tree must be covered with the spray.

JUST BEFORE THE BLOSSOMS OPEN, OR WHEN THEY ARE "IN THE PINK," a spraying must be made to prevent scab and other fungus disease and the canker-worm, bud-moth and a few other insects. For this and the sprayings that follow, use the dilute lime-sulphur or the bordeaux mixture. To every fifty gallons, add two or three lbs. of arsenate of lead. (With lime-sulphur, this is the only poison that can be used.)

IMMEDIATELY AFTER THE BLOSSOMS FALL, and before the calyx closes, another spraying must be made just like the one before. At this time direct the spray downward from above as much as possible, and with the highest pressure available, the object being to get some of the material into the calyx cups, to poison the larva of the codling moth when it attempts to enter.

This is a very necessary spraying. If well done it usually means a crop free from worms.

ABOUT TWO WEEKS AFTER THE ABOVE SPRAYING, make another. Use same mixture and poison as in previous spraying.

EARLY IN AUGUST, there will be a second generation of codling-moths. Just when this will occur for your locality can be determined. (See "When the codling-moth flies" page 23.)

Protect fall and winter varieties against the codling-moth and a possible late outbreak of scab. Use the usual amount of poison, but the *dilute* lime-sulphur, or the bordeaux, either of which can be made somewhat weaker than before.

THE LESSER APPLE-WORM, which works more superficially than the codling-moth, when present requires a spray of poison when standard winter varieties are from 1 to 1½ inches in diameter.

PLANT LICE of several kinds infest the apple tree, and their effect on the fruit and foliage depends largely on weather conditions.

The lice are hatched out by the time the buds turn pink and a spray of nicotine or some other contact spray is most effective at that time.

On the other hand, an early Spring with warm, dry weather following this time is unfavorable to the lice and they may fail to appear in large numbers during such seasons. Cold and wet and a late Spring are favorable to the rosy lice. In seasons of this character, spraying is almost imperative.

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The spray to use is one that kills by contact. Nicotine is best of all but expensive; *strong* tobacco tea will also produce results. For further information, see page 22.

FIRE BLIGHT has been very serious in apple trees in some parts of the State during the past few years.

For description and method of control see "TREATMENT FOR PEARS" on page 9.

GENERAL TREATMENT FOR SPRAYING PEACH ORCHARDS.

Inspect for scale insects, the same as for apple, and spray with *strong* lime-sulphur wash the same as directed for apple trees.

If this spraying is made, it will also prevent the leaf-curl disease. If the lime-sulphur spraying is not required, a spraying must be made to prevent the leaf curl which is often especially serious on Elbertas. For this spraying, use bordeaux mixture or the copper sulphate solution (2 pounds of copper sulphate dissolved in fifty gallons of water). It is very important that this spraying be made *before* the buds swell. If made after that time, it will not be successful in preventing the leaf curl.

If the fruit in your orchard is commonly affected with the rot and the scab (the small black specks usually on the upperside) and the curculio ("the insect that stings the fruit")—and most of the peach orchards in Michigan are affected with all of these—make sprayings as follows:

JUST AFTER THE BLOSSOMS DROP AND MOST OF THE "SHUCKS" HAVE FALLEN OFF, spray with poison, using 2 pounds of arsenate of lead in every 50 gallons of water.

(See under arsenate of lead page 20.)

Never use any arsenical other than arsenate of lead, on peach.

TWO WEEKS AFTER THE PREVIOUS SPRAYING, another must be made. This time use the self-boiled lime-sulphur and to every 50 gallons add 2 pounds of arsenate of lead. The *dilute* lime-sulphur has not been generally satisfactory on peaches. Even when *very dilute* some burning of the foliage has resulted.

ABOUT ONE MONTH BEFORE THE FRUIT RIPENS, spray again the same as directed above.

In orchards where the curculio is not present or not serious, the spraying recommended "Just after the blossoms fall" can be omitted.

Self-boiled lime-sulphur settles rapidly, so keep well agitated and do not add the arsenate of lead until just before spraying. Use fine nozzles and give the trees a uniform coating of mist-like spray.

PEACH TREE BORER. Dig out by hand early in spring or late in fall at points where gumming shows. Sterilize knife with carbolic acid to prevent spreading crown-gall which may be present.

"PEACH YELLOWS" AND "LITTLE PEACH."

These two diseases are extremely infectious and very difficult to positively identify. Their causes are unknown and the only method of control is destruction of the tree—fruit, root and branch—as soon as

discovered. It is especially important that diseased trees should not be allowed to blossom as it is believed the disease is spread by insects at that time. Both old and young trees of all varieties of peaches and probably all varieties of Japanese plums are susceptible to the two diseases. Both diseases may be present in a tree at the same time.

PEACH YELLOWS. The first symptoms in a young tree, previous to bearing, are indicated by the leaves of one or two limbs turning from a rich dark green to a "yellowish green or reddish rusty green" color; this is accompanied by a rolling of the leaves from their edges. These

PEACH YELLOWS.

A six year old peach tree in an advanced stage of the "Yellows."

leaves ripen and fall earlier than normal leaves. The fruit buds are larger and more mature in appearance and in the spring will invariably bloom earlier than healthy buds. In some instances, the symptons are not confined to one or two branches, but many of the leaves in the center of the tree turn yellowish or light green, roll slightly from their edges and droop considerably. These latter symptoms are often present in case of "Little Peach."

Upon bearing trees, there may be any one or all of the following symptoms: the fruit may ripen prematurely—one to three weeks—upon one or two branches or over the entire tree. The fruit may have numerous red spots on the surface, the spots sometimes extending in red streaks partially or wholly through the flesh to the pit. Often the flesh, about

the pit, is full of radiating streaks of red. The surface of the fruit may be smooth or considerably roughened and the flesh more or less stringy and very insipid. The leaves may be yellowish pale or reddish rusty-green in color, usually rolling and drooping. In advanced stages, numerous finely branched shoots bearing many slender sickly leaves,

CUTTING OUT BLIGHT.

Cutting out blight in a quince tree. The blight attacks pears, apples and quinces. Note the bottle containing the disinfecting material, and the sponge to apply same.

appear on the trunk or main limbs and sometimes in the extremities of the branches. *Finally the tree dies.*

Winter injury to the bark of the trunk or main limbs, mechanical injury by mice, rabbits, peach borers, cultivators, etc., or a serious lack of moisture or nitrogen in the soil may discolor the foliage and cause premature ripening of fruit and should not be mistaken for "Yellows."

LITTLE PEACH. In "Little Peach," characteristic symptoms are: the leaves of a part or the whole of the tree have a bunched appearance, and are shorter, and broader than normal leaves. They are usually yellowish-green in color with the veins appearing dilated and darker than the intervening tissue. The fruit is usually under size and ripens from a week to two weeks late. The flesh is more or less stringy, watery and very insipid while the pit is usually very small. One or all symptoms may be present and unless they can be positively attributed to some other cause, the tree should be condemned, pulled out and burned.

GENERAL TREATMENT FOR PEAR ORCHARDS.

Inspect for scale insects and if present, spray before the buds start with *strong lime-sulphur*. The *Pear Blister Mite* (a mite that causes thickened red and brown spots on the leaves) and the *Pear Psylla* may also be partially controlled by this spraying for scale. If these pests were serious last year, make the strong lime-sulphur spraying even if not needed for the San Jose scale.

APPLY THE SAME GENERAL TREATMENT TO PEARS as is given for apples. If the *dilute* lime-sulphur is used, it should not be as strong as for apples (see dilution table on last page).

PEAR BLIGHT OR FIRE BLIGHT was very serious last season in many parts of the state. It is easily noticed, a branch dies back from the tip, leaves turn brown, wither, but do not drop. Is caused by a germ that works within the twig and hence spraying is not a preventative. It usually is more serious in rapidly growing trees and for this reason, many pear orchards are left in sod. Cut out the diseased twigs and branches. Make a frequent and systematic inspection of every tree and cut out every diseased twig and branch found. Cut several inches below where the wood appears to be dead. Carry the dead portion out of the orchard and bury or burn. After every cut, wipe off the wound with a cloth or sponge moistened with a 5% carbolic acid solution.

If slugs appear, spray with an arsenical, if not too near ripening of fruit to be dangerous. In case of early pears *fresh* hydrated lime may be dusted on.

GENERAL TREATMENT FOR PLUMS.

Plum trees may be infested with the San Jose or by the European fruit scale. The treatment for them is the same as recommended for scale on apples. (Page 5.)

JUST BEFORE THE BUDS OPEN, spray with the *dilute* lime sulphur (or the bordeaux mixture) and arsenate of lead, 2½ to 3 lbs. to a barrel. This is to prevent leaf-spot, fruit rot, black knot and curculio.

Arsenate of lead is preferable to paris-green on all stone fruits, owing to tenderness of foliage in such fruits.

IMMEDIATELY AFTER THE BLOSSOMS FALL, it is very essential to make another spraying using the *dilute* lime-sulphur or bordeaux mixture or *self-boiled* lime-sulphur, and two pounds of arsenate of lead to every 50 gallons. (For the Japanese varieties use the self-boiled lime-sulphur

or dilute the bordeaux one-half.) This spraying is to prevent the leaf diseases, fruit rot and curculio. Be sure it is made *immediately* after blossoms fall. Our experiments last year showed that dilute lime-sulphur was very satisfactory on plums and it is easier to prepare and spray than bordeaux or *self-boiled* lime-sulphur.

Ten Days or Two Weeks Later, it will pay to repeat the previous spraying, especially if the weather is wet or the curculio is serious. This spraying should be repeated every ten days or two weeks until there is danger of staining the fruit; stopping at least a month before picking time.

On varieties especially susceptible to rot, an application of weak copper sulphate may be made about two weeks before ripening. One pound of copper sulphate to 150-200 gallons of water. No poison need be used.

Black Knot. Early in the spring a careful inspection should be made of every tree, and *all* "black knots" cut out and destroyed. Cut back several inches below the knot. Disinfecting cuts as for pear blight is not necessary. Wild cherry trees harbor the disease and if diseased ones are near plum or cherry orchards, they should be destroyed, if possible.

GENERAL TREATMENT FOR CHERRIES.

Cherry trees may be infested with San Jose scale. If found, the treatment is the same as that recommended for the apple.

Just Before the Blossoms Open, spray with dilute lime-sulphur, or bordeaux mixture. This is to prevent the rot and leaf spot troubles. Especially valuable on the English Morellos for the latter. Our experiments the last two seasons indicate that the dilute lime-sulphur is just as satisfactory as the bordeaux for cherries and either is better than the self-boiled lime-sulphur.

Just After the Blossoms Fall, make a spraying like the above with the addition of 2 pounds of arsenate of lead to every 50 gallons of spray solution. This spraying is directed against the rot and leaf spot, curculio and slug.

Ten Days or Two Weeks Later, it may be necessary to make another spraying like the previous one for the rot and leaf spot. The need for this spraying will depend upon the susceptibility of the variety to the rot and to the weather conditions of the season.

Large Black Lice may appear on the leaves at any time. A spraying of tobacco water (see page 22) will destroy them if applied before the leaves curl too tightly.

Slugs sometimes appear after the fruit is harvested, a spraying of arsenate of lead (2 or 3 pounds in 50 gallons of water) will destroy them.

GENERAL TREATMENT FOR GRAPES.

Grape vines are not often subject to attacks by scale insects so there is seldom need for a spraying with *strong* lime-sulphur before growth starts.

Do not use the *dilute* lime-sulphur at any time for grape spraying. It stunts or checks the growth of the berries. Use the bordeaux mixture.

Downy Mildew commonly called "Red Grape" was very destructive last season and caused large financial losses to growers who did not spray.

Black Rot has been a serious disease in recent seasons. Growers cannot afford to risk the loss it may cause by neglecting to spray.

These diseases and others will be prevented very largely by spraying as follows:

When the Shoots Are About 8 to 10 Inches Long, spray with bordeaux mixture for black rot and downy mildew.

Just Before Blooming spray again with bordeaux mixture for black rot and downy mildew and to every 50 gallons of bordeaux, add 2 or 3 pounds of arsenate of lead to poison the grape berry moth, and the rose-chafer. If this latter is serious use stronger poison even up to 5 lbs. to 50 gallons. A pint of the cheapest molasses added may help.

Just As the Blossoms Are Falling, make another spraying like the above.

About 10 Days or Two Weeks Later, it may be necessary to make another spraying like the two previous, but this will depend upon the weather conditions and the amount of rot and mildew prevalent. If later sprayings are thought to be necessary, some material should be used that will not stain the fruit such as weak copper sulphate solution. (See page 20.)

There are several grape insects that are found only in occasional vineyards, and then not every year. The grower should keep a sharp watch of his vines for them and if found, take prompt measures to destroy them. (If not familiar with their appearance send specimens to The Entomologist, East Lansing, Michigan.)

Those most likely to be found are the following:

Flea-beetles may appear at any time but are most likely to come as the buds open in early spring. Spray with bordeaux mixture and a strong poison, 3 or 4 pounds of arsenate of lead to every fifty gallons of the bordeaux, if early in spring. Later use less poison.

In vineyards where the grape-berry moth is serious, spray with bordeaux and an arsenical poison during the middle of July, before the 20th.

For leaf-hoppers, sometimes incorrectly called "Thrip," spray with nicotine or with kerosene-emulsion while the insects are young, and before they can fly. Later in the fall, clean up all rubbish and burn after cold weather sets in.

For climbing cut-worms, use cotton bands or bands of sticky mixture. On tender growth these can be put on strips of paper.

GENERAL TREATMENT FOR CURRANTS AND GOOSEBERRIES.

San Jose and European fruit scale are often found upon these bushes. Inspect carefully for them. If found, spray before growth starts with *strong* lime-sulphur.

Just as the Leaves are Expanding, spray with *dilute* lime-sulphur or

bordeaux and two pounds of arsenate of lead to every fifty gallons.

Repeat this spraying when the fruit is about one-fourth grown.

If worms trouble after this, use pyrethrum or hellebore.

Leaf bugs or aphids may appear. When they do, spray with nicotine or strong tobacco water while the bugs are red and wingless and before the leaves have become curled.

Gooseberry Mildew is a fungous disease that is especially troublesome on the English varieties as Industry, Columbus and Chautauqua. Spray with dilute lime-sulphur. Begin when the buds start and repeat every 10 days to two weeks until near picking time.

When Pruning, if a cane is cut that shows discolored pith, it may indicate the cane borer. Cut back to sound pith. Burn trimmings.

Wilted Foliage at any time indicates the cane borer. Cut out and burn.

GENERAL TREATMENT FOR RASPBERRIES, BLACKBERRIES AND DEWBERRIES.

SPRAYING POTATOES AND STRAWBERRIES.

Cut out the Fruit Bearing canes after the last picking has been made. This will lessen insect and disease troubles that may be harbored on the old canes and allow more room for the growth of the new canes.

Orange Rust may appear in May or June. It is easily identified by the bright orange color on the under sides of the leaves. There is no method of preventing this trouble. As soon as it is found, the bush should be dug out and burned. If allowed to remain the disease will spread and destroy many plants.

Anthracnose, identified by the grayish spots on the canes (also on leaves, but not conspicuous), is common in many berry fields. It does not yield to spraying unless very frequently done with bordeaux mixture and this may not be profitable. If desirable, make the first spraying when the new canes are 6 to 8 inches high and repeat every two weeks during the growing season.

Cutting out and burning the old canes immediately after fruiting will be of some benefit. In starting a new field, make a special effort to secure healthy plants.

"Worms" or "Slugs" might appear at any time. Spray with an arsenical if early in season, but if near picking time, use hellebore or pyrethrum.

Cut out and burn gouty galls, tree cricket eggs or borers in stems.

GENERAL TREATMENT FOR STRAWBERRIES.

Examine the young plants before setting them. Pick off all discolored or diseased leaves. If root lice are suspected, dip the roots in strong tobacco-water.

After the growth starts, spray with bordeaux and a poison to prevent the leaf spot and to destroy the leaf-roller insect that may be present.

For fruiting plantations, spray with bordeaux before blossoming and repeat ten days to two weeks later. After fruiting if the bed is to be fruited again, mow and burn over quickly (as on a day when there is a wind, to avoid burning the crowns of the plants). If leaf rollers have been present, spray with poison after the growth has started again, but before the leaves curl.

For strawberry root lice, see Michigan Bulletin No. 244, page 88.

GENERAL TREATMENT FOR POTATOES.

For the Potato Scab. Soak the uncut tubers for two hours in 30 gallons of water and one pint of formalin (can be secured of any druggist). This solution can be used several times. Do not put treated tubers back into crates or bags that held scabby potatoes. Make the treatment only a few days before planting if possible. Do not plant upon land that has recently grown crops of scabby potatoes or beets.

For the Blight and "Bugs." Begin spraying with bordeaux mixture and poison when the "bugs" first appear, or when the plants are about 8 inches high, and repeat about every 2 weeks as long as the plants are growing. Spray often in warm, muggy weather; fewer sprayings are necessary in dry weather.

Use bordeaux mixture (6 pounds copper sulphate and 4 or 5 pounds of lime to 50 gallons of water, and put in the poison, about ½ pound of Paris green or 2 pounds of arsenate of lead, or 1 quart of the stock solution of Kedzie mixture.

Dilute lime-sulphur is not as good as the bordeaux mixture for potatoes.

Wart Disease of the Potato. This disease also is known as Black Scab, Canker or Cauliflower Disease. It attacks the tubers mainly. In a severe attack, big, dark warty excrescences sometimes as large as the tuber itself appear at the sides or ends. In advanced stages of the disease, the tubers are wholly covered by this growth and lose all resemblance to potatoes. In the final stages, the tubers turn to brownish black soft masses, giving off a very unpleasant odor. In very mild at-

tacks, the tubers appear normal, but the eyes are found to have turned gray, then brown and finally black.

This disease is not known to be present in Michigan, but is likely to be found at any time. No remedy is known. When once introduced into a field, the whole crop should be burned and no tuber from the field used for seed purposes. The field itself should not be used for potatoes for at least six or seven years and the disease should be reported together with specimens at the first outbreak or suspicion of outbreak to the Department of Botany, Michigan Agricultural College.

Send specimens in a tight mailing-case.

GENERAL TREATMENT FOR TOMATOES.

The Leaf Blight (*Septoria lycopersici* Speg.), caused serious losses in some tomato growing sections last season. This disease can be easily and cheaply controlled by proper spraying and growers should be equipped to do this important work.

In a test made last season by the Horticultural Department on the farm of Mr. G. C. Raviler at Plymouth, the best results were secured from four sprayings of Bordeaux mixture made with five pounds of copper sulphate, four pounds of stone lime and fifty gallons of water. The first spraying was made about a month after the plants had been set out and repeated every ten days or two weeks so that the new foliage was protected.

GENERAL TREATMENT FOR MUSKMELONS AND CUCUMBERS.

To protect these plants from fungous diseases spray with bordeaux mixture made with two pounds of copper sulphate, four pounds of stone lime and fifty gallons of water.

Begin spraying when the vines have runners a foot long and repeat once a week or every ten days as long as pickings are made.

Thorough sprayings of muskmelons and cucumbers will undoubtedly be a paying practice in most seasons.

Several insects interfere with the welfare of cucumber and melon vines. The cucumber beetle (striped) feeds on the leaves, and the young tunnel as grubs in the roots. Plant more seeds than are needed to produce vines and then thin out injured plants and dust with hydrated lime and flour of sulphur, (one of sulphur to five or six of lime) through coarse cloth. Some prefer arsenate of lead powder mixed with nine parts of hydrated lime. About the bases of the vines on the ground throw some tobacco dust to prevent beetles from laying eggs on stems. Paris green is not reliable on these tender vines.

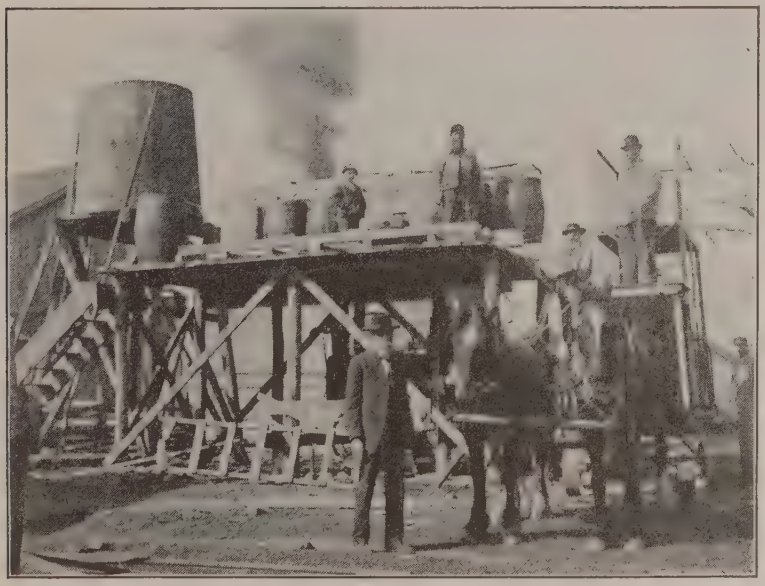
The cucumber louse usually starts in a few hills and then spreads over the field. Cold, wet weather being favorable to the louse. Some prefer to bury the first few vines attacked to retard spreading. A good spray is Persian insect powder, ½ oz. to a gallon of water, spraying upward from beneath. The difficulty lies in getting the spray on to the lice. Each louse must be fairly hit to be killed.

The large black squash bug, or stink bug, not only feeds on vines but probably also carries the wilt. It may be trapped on cold nights under pieces of board and dropped into a can of water, having a little kerosene on top.

PREPARATION OF SPRAY MIXTURES.

STRONG LIME-SULPHUR.

Strong lime-sulphur to be used on dormant trees or bushes for scale insects, can be prepared in three ways:



A HOME COOKING PLANT.

An outfit for the cooking of the lime-sulphur at home. Water supply tank on the left. The cooking is done in barrels into which are extended perforated steam pipes. The steam is supplied by traction boiler.

By the old formula.
By reducing with water "the home-made" concentrated wash.
By reducing with water the "commercial" concentrated wash.
The "Old formula" has been used for many years with good results and is very satisfactory. The formula is as follows:

Lump lime	20 pounds
Sulphur (flour)	15 pounds
Water (hot) to make	50 gallons

The lime is slaked with a small amount of water (hot if lime is sluggish) and the sulphur is added, fifteen or twenty gallons of water are then added, and the mixture boiled. (It should take three-quarters of an hour, or an hour of good boiling with frequent stirring.) When done the liquid should be amber colored and fairly clear. Strain, dilute with water (hot is preferable) to make (up to) 50 gallons, and apply warm, through a coarse nozzle.

If small quantities are required, use an iron kettle to boil it in. If larger quantities are to be used, live steam is preferable for boiling purposes, either in a tank or in barrels.

Applied just before the buds swell, it coats the branches in such a way as partially to hinder from settling down, such pests as the oyster-shell, scurfy scale, some aphids and other insects.

HOME-MADE CONCENTRATED LIME-SULPHUR WASH.

Growers, having cooking plants, can make the lime-sulphur wash in a "concentrated" solution. This may be an economy of time, as large quantities can be made early in the season and stored until needed.

It is difficult to make this wash of uniform strength. For this reason, every batch that is made must be tested with a hydrometer and diluted accordingly.

The difficulty of getting a solution of uniform strength, apparently depends on the lime, which varies in composition and strength. Lime that contains more than five per cent of magnesium oxide and less than 90 per cent of calcium oxide does not combine in the cooking with the sulphur in a way to make a good mixture. Special "spraying lime" is now on the market.

There are several ways of combining the lime and sulphur, but always there are two parts, by weight, of sulphur to one of stone lime. The following three formulas are in common use:

Stone lime	75 lbs.			60 lbs.			40 lbs.
Sulphur	150 lbs.	or		120 lbs.	or		80 lbs.
Water	50 gal.			50 gal.			50 gal.

The lime is slaked to a thin paste and the sulphur is added. Boil for one hour and stir frequently. Water enough should be added so that there will be fifty gallons at the end of boiling.

After it is cooked, if not to be used at once, it should be strained into a barrel which should be air tight, as exposure to the air causes the sulphur compounds to lose their value for spraying purposes. Each lot that is cooked should be tested with a hydrometer when cooled and diluted, according to the dilution table on last page, when applied.

COMMERCIAL CONCENTRATED LIME-SULPHUR WASH.

There are several brands of the "commercial" concentrated lime-sulphur solution now upon the market. The use of these instead of the home cooked kinds is becoming more and more common every year, especially by fruit growers who do not care to take the time or trouble to cook the material for themselves or if they do not have good facilities to do so. They are now reasonable in price,—of fairly uniform strength, and do add to the ease of getting ready to spray as all that is necessary is to dilute with the required quantity of water.

TESTING AND DILUTING CONCENTRATED LIME-SULPHUR.

Every "batch" of the home made concentrated lime-sulphur wash will have to be tested when cooled to determine its strength and it will be well to test the "commercial" brands. This testing is done with a Baume hydrometer. It is a simple instrument used to determine the weight and density of liquids. It is made of glass, is about a foot long, and has a graduated scale on the side.

It is absolutely necessary that the hydrometer be kept *perfectly clean.* If the solution is allowed to dry on it an accurate test cannot be made.

It can be purchased from dealers in druggists' supplies or from Bausch and Lomb Optical Company, Rochester, N. Y., or Whitall Tatum Company, Philadelphia, Pa., or Taylor Instrument Companies, Rochester, N. Y.

(See last page for the rates of dilutions.)

AMOUNT OF SULPHUR IN SOLUTION.

The relation between the "Baume Test" and the sulphur in solution in the commercial or home made concentrated lime-sulphur wash can be determined from the following table:

Density, degrees. Baume.	Total sulfur. %	Pounds of sulfur in one gallon of solution.
33	26.0	2.7
32	25.0	2.6
31	24.0	2.5
30	23.0	2.4
29	22.0	2.3
28	21.0	2.2
27	20.0	2.1
26	19.5	2.0
25	19.0	1.9
24	18.5	1.8
23	18.0	1.8
22	17.75	1.7
21	17.0	1.6
20	16.75	1.6
19	16.25	1.5
18	16.0	1.5
17	15.5	1.4

DILUTE LIME-SULPHUR SOLUTION.

For spraying on the foliage of apples, pears, European plums and cherries but not on peaches or Japanese plums, grapes or potatoes.

This solution can be prepared for use in several ways.

First, The "Commercial" concentrated lime-sulphur solution can be diluted to the proper strength.

Second, The "home made" concentrated lime-sulphur can be diluted to the proper strength.

Third, The solution can be made at any time and in any quantity as follows: Boil in a few gallons of water for one hour, *twice* as many pounds of sulphur as of lime, strain and dilute with water so there will be 8 pounds of sulphur to every 100 gallons.

Example: To make 100 gallons of spray solution, boil 8 pounds of sulphur and 4 pounds of lime as directed.

SELF-BOILED LIME SULPHUR MIXTURE.

This is a mixture of lime, sulphur and water and not like any of the other lime-sulphur sprays. It does not (when properly made) injure tender foliage and is very valuable for spraying peaches and Japanese plums. The formula is:

Lump lime	8 pounds.
Sulphur	8 pounds.
Water	50 gallons.

The mixture can be prepared better by using thirty-two pounds of lime, thirty-two pounds of sulphur, and eight or ten gallons of water, and then diluting to 200 gallons.

Place the lime in a barrel and add enough water to almost cover it, as soon as the slaking begins, add the sulphur, which should be run through a sieve to break up the lumps.

Stir constantly and add enough water to make a thick paste and then, gradually, a thin paste. As soon as the lime is well slaked, cold water should be added to cool the mixture and prevent further cooking. It is then ready to be strained into the spray tank, diluted up to the full formula, and used.

Care must be taken not to allow the boiling to proceed too far, if the mixture remains hot for fifteen or twenty minutes after the slaking is completed, some sulphur will go into solution and injury to the foliage may result.

The time of adding the cold water to stop the boiling depends upon the lime. With a sluggish lime all the heat in it may be needed, while with limes that become intensely hot, care must be taken not to allow the boiling to proceed too far.

SOLUBLE SULPHUR POWDER.

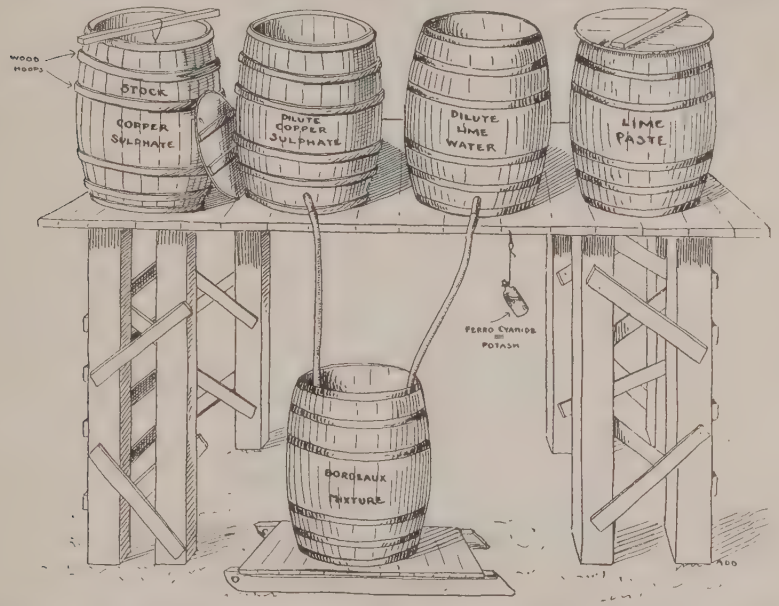
Soluble sulphur powder, although it is less known than other sulphur compounds, has proven in our tests, of about equal value with commercial lime sulphur when used as a Winter spray on dormant trees against the San Jose scale.

BORDEAUX MIXTURE.

Bordeaux mixture is made of copper sulphate, lime and water.

These three substances are combined in various proportions, depending upon the kind of plant to be treated. For apples, pears, cherries and plums (except Japanese varieties) the preparation is usually four

pounds of copper sulphate, with about the same amount of lime, to fifty gallons of water. Poison is added as needed. The copper sulphate will readily dissolve in two gallons of hot water, to which should be added enough water to make twenty-five gallons or one-half barrel. Do not use an iron or tin vessel to dissolve this in, as the copper sulphate will de-



stroy it, and besides the iron will spoil the bordeaux. A wooden pail is good. Slake the lime into a thin paste and add water to make twenty-five gallons. Pour, or let these run together into a third barrel, and the bordeaux is made. When it is emptied into the spray barrel or tank, it should be strained through a brass wire strainer to catch any of the coarse particles.

Whenever it is necessary to use a quantity of the mixture, it is desirable to have the lime and copper sulphate in "stock solutions." A quantity of lime is slaked to a paste and held so by being covered with water. The copper sulphate, say fifty pounds, is placed in a clean gunny sack and suspended in a barrel (one with wood hoops is much to be preferred) containing twenty-five gallons of water. This will dissolve in about a day. One gallon of this "stock solution"* is equal to two pounds of copper sulphate.

A good quick way to combine these three substances is as follows: Put the amount of the "stock solution" of copper sulphate required in a barrel, and add enough water to make 25 gallons, or one-half barrel. Put about 7 pounds of the lime paste in a barrel and add 25 gallons of water, making a thin whitewash. Pour, or let these two run together into a third barrel, or directly into the spray barrel or tank, being sure

*Always stir this "stock solution" before dipping any out, in order that what is used may be full strength.

to strain. When partly run in, test with ferro-cyanide of potash† to make sure enough lime has been used. If Paris green, arsenate of lead, or any other poison is to be used, make it into a thin paste with a little water and add it to the bordeaux mixture, which is now ready to be used.

COPPER SULPHATE SOLUTION.

Copper sulphate solution is copper-sulphate dissolved in water. It is used by some growers to spray peach trees to prevent the leaf curl where a spraying for scale insects is not required. Two pounds of copper sulphate to 50 gallons of water is strong enough for this purpose.

POISONS USED IN SPRAYING.

For Insects That Chew.

ARSENATE OF LEAD.

This poison is used very extensively. It can be secured for a reasonable price, is ready to use at any time, does not easily injure the foliage and is the only poison that can be safely used in the lime-sulphur sprays.

Injury to tender foliage like the peach has occasionally occurred by spraying with arsenate of lead and water when the foliage was moist from dew or rain. If necessary to spray tender foliage (peaches or Japanese plums) at such a time it would be well to add 3 to 5 pounds of slaked lime to every 50 gallons of the spraying material.

Arsenate of lead is usually sold in kegs or "kits" or small barrels in the form of a paste. Some companies have it in a powdered form. This form usually costs twice as much or more per pound as the paste form and since it does not contain much water only one-half the amount in weight should be used as is recommended for the paste form.

A simple, easy way to work the thick pasty arsenate of lead into a thin, smooth paste (as it should be before using either alone or in something) is to put the amount required in a keg; add water and churn with a dasher. This is much quicker than to use a paddle.

PARIS GREEN AND LIME.

Always use lime with paris green, it makes the poison stick better, besides greatly reducing the danger of burning the foliage.

† This chemical can be secured of any druggist. Ten cents, worth dissolved in a pint of water will be enough for a season. Drop a very little in the bordeaux, if a reddish brown color appears more lime must be added. If there is no discoloration, there is enough lime. Ferro-cyanide of potash is extremely poisonous, so observe great care in its use.

For spraying from a barrel, the writer has found the following method very useful: Place from one-quarter to one-half pound of good lump lime, or unslaked lime, in each of three or four tin pails which will hold about three quarts or less. Old cans or crocks will answer just as well. Add enough hot water to slake it into a thin cream or paste. Now add to each lot, one-quarter pound of paris green, previously weighed out, and placed in paper bags, stir while the lime is hot and allow to stand for some time. Now measure out about forty-four gallons of water in your spraying barrel, and make a mark that will show how high it comes in the barrel, add the contents of one tin pail (viz., one-quarter of a pound of paris green and one-half pound of quick-lime slaked) into the forty-four gallons of water in the barrel. Stir well and spray. The pails or crocks can be used one at a time and refilled occasionally so that the stock is always on hand ready for use.

ARSENATE OF SODA—KEDZIE FORMULA.

This form of poison was originated at this Station by the late Dr. R. C. Kedzie.

This is a cheap, effective poison that can be prepared at home. It is used by many of the grape growers of Michigan in combination with the bordeaux mixture. It cannot be used in the lime-sulphur sprays. If used alone—as is sometimes done for potato bugs—slaked lime must be added or the foliage will be burned.

The formula is:

White arsenic	2 pounds
Sal Soda (commonly called washing soda)	8 pounds
Water	2 gallons

Boil these materials in any iron pot or kettle *not used for other purposes* for about 15 minutes or until the arsenic dissolves, leaving only a small muddy sediment. Put this solution into a jug or other vessel that can be closed tightly and labeled "Poison."

One quart of this solution is equal to ½ pound of Paris green. For most spraying one quart in 50 gallons of water (with some lime) or bordeaux mixture will be sufficient.

CONTACT INSECTICIDES, FOR INSECTS THAT SUCK.

KEROSENE EMULSION.

Place two gallons of ordinary kerosene in a warm place, either in a warm room or in the sun, and allow to become as warm as possible without danger from fire. Boil one pound of laundry soap or whale oil soap in a gallon of soft water until completely dissolved. Remove the soap solution from the fire, and while still boiling hot, add the kerosene and agitate vigorously for ten minutes, or until the oil is emulsified, with a spraying pump by forcing the liquid back into the vessel from which it was pumped. When the liquid is perfectly emulsified it will appear creamy in color and will flow evenly down the side of the vessel when allowed to do so. Care should be taken to completely emulsify the oil and this is accomplished much more easily when the mixture is hot.

This strong emulsion may now be readily diluted with water and used, or it may be stored away for future use. When cold it becomes like sour milk in appearance and should be dissolved in three or four times

its bulk of hot water before diluting with cold water. If the water is at all hard, "break" it by adding a little sal soda before putting in the soap.

Small amounts of this emulsion may be made by using the ingredients in small quantities, but in the same relative proportion. It is used at the rate of eight or ten parts of water to one part of emulsion.

HELLEBORE.

White hellebore is the powdered root of a plant. It kills both by contact and as an internal poison. It may be applied either dry or in the form of a liquid. When used dry it should be mixed with three or four times its weight of flour or of plaster and then dusted on the insects. Applied wet, one pound should be mixed with twenty-five gallons of water and this liquid applied as a spray.

INSECT POWDER, BUHACH, PYRETHRUM.

This valuable remedy has one drawback, its cost. It is too expensive for use on a large scale. It kills insects through their breathing pores, but is harmless to man and beast. It will kill many of the insects of the garden if dusted on or applied as a spray at the rate of one ounce to two gallons of water.

Use the powder when it is undesirable to use poison, but never buy any unless it comes in tightly sealed packages. It loses its strength on short exposure to the air. An hour will suffice to weaken it. It must be applied from time to time, as it quickly loses its strength.

TOBACCO.

Tobacco in the form of dust may be obtained of the large manufacturers for a few cents a pound.

It is useful in destroying root-lice, especially wooly-aphis, in young trees, and in keeping insects from garden truck. For root-aphis, incorporate four to six handfuls of tobacco dust into the soil about the roots and induce a thrifty, healthy growth by using liberal quantities of nitrate of soda or barnyard manure early in the spring.

A *strong* infusion or tea made of waste will kill plant lice if sprayed when they first appear.

Nicotine is to be had now in concentrated form. It is more often sold about 40 per cent strong. This may be diluted many hundreds of times before applying. As there is a diversity of grades and brands to be had, it will be well to use the strength recommended by the makers.

HYDRATED LIME.

Finely slaked lime is often useful because of its slight caustic properties. Against such larvae of saw-flies and beetles as are sticky, for instance, those of the cherry-slug and asparagus-beetle, it may be used as a substitute for poison, if the latter, for some reason is undesirable.

Stone lime may be slaked with a small amount of hot water, using just enough to turn it to a dry powder. Such slaked lime is as fine as flour and very soft to the touch, having very little grit. Use a metal pail or kettle to slake in, as the heat may set fire to wood. Do not use too much water, and where possible, use freshly burned lime.

Hydrated lime may be used in making bordeaux mixture, but it is not as reliable as good, fresh, lump lime. It is less adhesive, not as strong

(so more should be used) and more expensive. The one advantage is that it is a little easier to use.

Ground lime for making bordeaux mixture acts exactly like lump lime, if fresh, but this is difficult to determine as it is already in a powder.

CAUTIONS.

Do not spray while plants are in bloom. It is prohibited by law, except when canker-worm is present, and may destroy bees and other beneficial insects.

Do not dissolve copper sulphate in an iron or tin vessel. It will ruin the vessel and spoil the spraying solution.

For all spraying solutions containing copper sulphate, the pump must be brass or porcelain lined.

Wash out pump and entire outfit each time after using.

Use arsenate of lead on stone fruits in preference to other forms of arsenical poisons. It is less liable to burn the foliage.

Do not spray fruits or plants with poison within a month or more of the time when they are to be picked.

Keep all "stock solutions" covered to prevent evaporation.

Do not spend money for freak "cure-alls" such as powders to be put into a hole bored in the trunk or limbs of trees or liquids to be diluted and poured on the ground beneath the trees. They may do considerable harm.

WHEN THE CODLING-MOTH FLIES.

While the first week in August is a good average time for applying an arsenical spray for the second generation of the Codling-moth in Michigan, it is well to remember that seasons vary, and that the time set aims merely at an average. To determine exactly each year just when to get the highest efficiency out of a spray, for a particular locality, requires only a few hours of work, providing one can find some neglected apple trees near at hand.

First of all scrape off all loose bark-flakes from the trunk and limbs of several trees, thus destroying all the natural places for the hiding away of the cocoons. The scraping is most easily done while the bark is soft after a prolonged rain.

Next, make some bands of burlap six or eight inches broad and three or four layers thick; place one around the trunk of each prepared tree and fasten with a headless wire nail driven into the tree so that the band can easily be removed. Do this in June so that the cloth may become weathered before the time for spinning. The larvae in searching for a good place to spin cocoons will find the bands, in the absence of other protection, and spin cocoons there.

Occasional examinations during July will reveal these cocoons, which should be carefully removed by cutting out a small bit of the cloth to which each is fastened.

Place all these bits of cloth with the cocoons attached in a cage made of a lantern globe or some other glass cylinder open at top and bottom, and then tie a bit of mosquito netting over the top to confine the insects when they come out of the cocoons. If the lantern globe is set on a little soil in a flower pot and the soil is kept just slightly moist, the chances of getting the moths out are increased.

Now put the cage thus prepared in a shady place where the sun cannot

strike it to sweat it, and where the rain cannot penetrate. Outside of protection from rain and sun the conditions should be as near those of the outside as possible. Keep the soil in the pot just moist and look for the moths often during late July for they will hide down under the layers of burlap and may be overlooked. When you see them in the cage, then you will know that they are laying eggs in the orchard and the time to spray is just before the young hatch and go into the fruit, which is about a week or ten days later, not afterward. Of course, they do not come out all together, but string along over quite a period.

TABLE OF DILUTIONS FOR CONCENTRATED LIME-SULPHUR WASH.

To spray for San Jose and other scale insects.		Summer Sprayings for Apples, Cherries, and European Plums.	
If Baume test is	Amount below should be diluted to 50 gallons.	If Baume test is	Amount below should be diluted to 50 gallons.
33	6¼ gallons	33, 32 or 31	1¼ gallons
32	6½ gallons	30, 29 or 28	1½ gallons
31	6¾ gallons	27, 26 or 25	1¾ gallons
30	7 gallons	24, 23 or 22	2 gallons
29	7½ gallons	21, 20 or 19	2¼ gallons
28	7¾ gallons		
27	8¼ gallons		
26	8¾ gallons		
25	9 gallons	Summer Spraying of Pears.	
24	9½ gallons		
23	9¾ gallons		
22	10 gallons		
21	10½ gallons	33, 32 or 31	1 gallon
20	10¾ gallons	30, 29 or 28	1¼ gallons
19	11¼ gallons	27, 26 or 25	1½ gallons
18	11½ gallons	24, 23 or 22	1¾ gallons
17	12 gallons	21, 20 or 19	2 gallons